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ELECTROENCEPHALOGRAPHIC CHANGES IN ALBINO RATS SUBJECTED TO STRESS

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16. Abstract Twenty-one albino Wistar rats were subjected to stress for 7 hours. There was a significant difference in the slopes of regression lines for 7 non-ulcerous rats and those for 14 ulcerous rats. Non-ulcerous rats subjected to stress showed greater EEG curve synchronization than did ulcerous rats. If curve synchronization can be equated to a relaxed state, it may therefore be possible to explain the protective action of hypnotics, tranquilizers and analgesics on ulcers.			
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ELECTROENCEPHALOGRAPHIC CHANGES IN ALBINO RATS SUBJECTED TO STRESS

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Since its description by Bonfils and Lambling [1] in 1956, the stress ulcer of the albino rat has been the subject of many studies of the physiopathological factors which affect its occurrence, and the pharmacodynamic factors which prevent its occurrence. But to the best of our knowledge, no studies have been made of changes in electroencephalograms during stress, nor of the differences which might be revealed between the EEG curves of animals which, under stress, show gastric ulcers and those of animals which are spontaneously free of gastric ulcers under stress. /1639*

Experimental Procedure

We utilized 21 female albino Wistar rats with an average weight of 200 grams. The rats had previously had permanent cortical electrodes implanted while under anesthesia by mephobarbital. (Stainless steel screws were implanted in the cranial bones perpendicular to the frontal, parietal and occipital cortices, then soldered to the pins of a female microconnector. The entire assembly was stabilized and attached to the bone by means of an acrylic-resin-based dental cement.)

The animals rested for one week and then fasted for a total of 24 hours. They were then subjected to stress for 7 hours by being placed in a bottomless parallelipedal box, 22 cm² in area, whose length was adjustable by means of wooden blocks. Lateral openings ensured ventilation, and an upper opening made it possible to connect the female microconnector to a male connector which was in turn connected to the EEG recorder (an Alvar Reega IV moving ink pen). Stress was consistently administered between 11:45 AM and 6:45 PM in order to avoid the effects of spontaneous temporal variations in the EEG.

*Numbers in the margin indicate pagination in the French text.

The first experiments were made in November 1966, and the last in March 1967.

Recordings were made by means of a bipolar assembly at the level of the frontal, parietal and occipital cortices. We also recorded the electromyogram at the level of the nape (with this recording serving as a sort of actogram of the animals), and the DII electrocardiogram. For the first four animals, we made a continuous recording of the EEG during 7 hours of stress, at a speed of 2.5 mm/second. This test revealed that the curves begin to appear only after 2.5 hours of stress. Therefore, /1640 we subsequently began recording at this point, and reduced the recording periods to 5-minute sequences, taken every 15 minutes during a 4.5-hour period.

Upon conclusion of stress administration, the animals were all sacrificed by decapitation and the stomachs were excised. The stomachs were opened along the long axis, rinsed under running water and examined through a binocular lens. In accordance with the Bonfils standards, we considered the response to be positive when as few as one necro-hemorrhagic lesion was observed.

When the curves were analyzed, we determined the total duration of low-frequency and high-voltage phenomena (so-called "synchronized" phenomena), which we expressed as a percentage of the total duration of the recording period.

Results

During the first two hours of stress, the animals moved in agitated fashion in their cages (as indicated by a very active electromyogram), and created dissynchronous curves (low voltage and high frequency). Subsequently, the animals calmed themselves (more or less), and the percentages of slow phenomena in their curves increased progressively until the end of the period of stress. The curves of animals which were spontaneously protected were different from those of ulcerous animals.

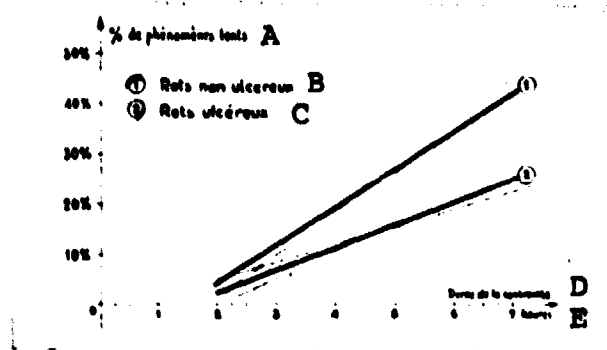


Figure 1.

KEY:

- A: Percentage of slow phenomena
- B: Non-ulcerous rats
- C: Ulcerous rats
- D: Duration of stress
- E: Hours

Slope of regression line	$\beta_1 = 1.82 \pm 0.364$	Slope of regression line	$\beta_2 = 1.14 \pm 0.20$
Linearity test	Linear $F = 100.63$ $(F_{110}^1 \text{ at } .01 = 6.85)$ Non-linear $F = 0.58$ $(F_{110}^{17} \text{ at } .01 = 2.19)$	Linearity test	Linear $F = 125.07$ $(F_{245}^1 \text{ at } .01 = 6.63)$ Non-linear $F = 1.19$ $(F_{245}^{17} \text{ at } .01 = 2.04)$
Normality test of $y - \beta x$	$\chi^2 = 8.08$ $\nu = 8$	Normality test of $y - \beta x$	$\chi^2 = 7.69$ $\nu = 8$
Comparison of slopes $t = \frac{\beta_1 - \beta_2}{S(\beta_1 \beta_2)} = 3.579$			

A. Spontaneously Protected Animals:

/1641

For seven subjects which showed no ulcers (i.e., 33%), the curves showed slow phenomena which reached a maximum of 40%.

Study of regression as a function of time makes it possible to confirm that the percentage of slow phenomena develops linearly, with the slope of the regression line being $\beta = 1.82 \pm 0.364$. There was no non-linear regression (see chart on preceding page).

B. Ulcerous Animals:

The percentage of slow phenomena was less than it was in the preceding case, and did not exceed 25%. Study of regression as a function of time (confirmed by the practical linearity test) also makes it possible to confirm that the percentage of slow phenomena develops linearly, with the slope of the regression line being $\beta_2 = 1.14 \pm 0.200$. There was no non-linear regression (see chart on preceding page).

In both cases, we verified that the distribution of the percentage of slow phenomena was comparable to normal distribution, taking into account the corresponding regressions.

Conclusions

In albino rats subjected to stress for 7 hours, the percentage of synchronized phases of the EEG curve increases after 2 hours, until the end of the period of stress, i.e., during the period in which ulcers begin to form. Animals without gastric ulcers show significantly greater synchronization of the EEG curve than do animals with ulcers. To the extent to which a correlation can be drawn between this curve synchronization and a more marked state of subject indifference or relaxation, it may be possible to explain the protective action on stress ulcers of many medications which synchronize electrogenesis (hypnotics, tranquilizers and analgesics).

It is also well known that psychological conflicts and anxiety encourage the onset of debilitating crises among ulcerous humans.

Based on their EEG curves, rats which reveal gastric ulcers under stress appear to be less able to dissociate themselves from surrounding conditions than are protected animals. The analogy with human psychosomatic factors is clear. This finding also explains the favorable therapeutic effect of tranquilizers in prevention of human ulcer-related crises.

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1. Rossi, G., S. Bonfils, G. Lieffogh and A. Lambling, C.R.Soc.Biol., 150, 21 (1956).